SOCIO-ECONOMIC STUDY OF THE PROPOSED SHELL OIL COMPANY PEARL MINE

INTERIM REPORT VOLUME 2

The Proposed Development and The Study Approach

RECEIVED
'77 NOV 23 PM 1:44
STATE OF MONTANA
DEPT. OF STATE LANDS
AND INVESTMENTS

Submitted To:

THE MONTANA DEPARTMENT
OF
STATE LANDS

November 21, 1977

This report is in the preliminary Review Draft stage. As such it represents neither the final judgement nor the official position of the Meadowlark Group or the State of Montana.

P.O.Box 1050
Helena, Montana 59601
406/442-9873

1110 South Third Avenue
Bozeman, Montana 59715
406/587-3560

TABLE OF CONTENTS: THE PROPOSED DEVELOPMENT AND THE STUDY APPROACH

Section I. The Proposed Development 1

A. Shell's Proposed Pearl Mine 2

B. Other Energy Development Activity in the Area. 9

C. Pearl Mine Impact Analysis Scenarios 14

D. Coal Mining and Employment 16

Section II. Socio-Economic Impacts: Role and Scope Statement. 23

I. Impacts: Positive and Negative 23

II. Scope of the Impact Area. 26

III. Mitigation Strategies: "pay as you go?". . . . 28

Any impact study must begin with an understanding and description of the proposed action which is being examined. This paper describes various aspects of the proposed mine which have implications for human impacts. It is clear that if the Pearl Mine is developed, its effects will be felt in a setting already experiencing the effects of other developments. While there is considerable uncertainty surrounding the timing and magnitude of new coal developments in the general impact area, this paper examines other possible coal-based activity. For purposes of analysis, three distinct levels of possible future development were assumed. The rationale for these three scenarios is developed here. Perhaps the greatest single feature of importance about a possible new energy development from the standpoint of its human impact is the level of employment associated with its construction and later its operation. For this reason, the topic of coal mining and employment is discussed.

To more thoroughly convey the approach used in performing this study, as well as to set the scene for the detailed topical reports which have been developed, the second major portion of this paper has been included. It conveys the team's perception of the role and scope of socio-economic statements. This section provides a stepping off point for the balance of the report.

Shell's Proposed Pearl Mine.

Information on the manpower requirements for the Pearl Mine is sketchy. On page 6 of Volume 1 of Shell Oil Company's mine and reclamation plan for the Pearl Mine, it states, "Coal will be removed at an average rate of two million tons per year. Due to normal start-up delays, the production rate during the first and second years of operation is forecast to be approximately one and one half million tons per year." Identifying a difference in mining technique from other large scale Montana strip mines, all of which use draglines for overburden removal, the plan further states, "Mining will be conducted by the conventional truck and shovel method." Once extracted, coal will be crushed and loaded out from silos into rail cars.

While geological data indicate the presence of 60 million in-place tons of coal beneath the 541-acre Shell Federal lease, it is estimated that actual coal recovery will approximate 38.5 million tons, with a total mine life of some 20 years for the entire project.

> "The method of mining to be used in this project will be a terrace or level-bench system utilizing power shovels and front-end loaders to load rear dump haulage trucks. In this system the overburden and coal will be removed from the pit by the excavation of 50-foot thick layers or benches. The overburden will be hauled by the rear dump trucks back to the previously mined cut and used as backfill, except for the overburden in the initial cut which will be hauled to the overburden stockpile area and stored until it can be used to fill the final cut of the mining sequence. The coal will be loaded by the shovels as it is encountered in each bench and hauled to the load-out facilities." p. 46, Mine Plan.

The mining plan shows the first ten years devoted to the south pit, then moving to the northwest pit for the second ten years. The mining will end at the northeast corner of the northwest pit, adjacent to adjoining coal reserves not presently held by Shell. This is being done so that mining could be easily continued to these adjoining lands.

Table 1, based on information from pages 51 and 52 of the mine plan, depicts 5 annual levels of production, overburden moved, coal recovered, and disturbed and reclaimed acres from year one through year twenty two. (See Table 1)

In addition to the mine itself, its operation will require the construction of a railroad spur line approximately 2.84 miles long. It would be an extension of a proposed railspur for the Youngs Creek area shown on Plate 9 and Figure 15 of the mine plan. The spur would end in a loop designed to facilitate rapid loading of an estimated four (4) unit trains per week (100 rail cars @ 100 T each). The loadout station would consist of overtrack storage silos. The mine plan notes that the silos and railroad loop may be left when the presently contemplated area is mined out, as they might be used by other potential mines in the area.

Opening the mine will also require the construction of a 13.8 KV feed line between the existing Decker powerline (approximately 6.78 miles southeast of the property) and a new substation located on the north portion of the site. A new transformer would be installed at the main line connection to reduce the high voltage to 13.8 KV for the feed line. Power consumption is estimated to be about 11,000,000 KW per year maximum. On-site buildings will be constructed for mine administrative and engineering personnel, change house for work force, shop-warehouse, and so forth.

The coal handling and storage element is described as follows on page 79 of the mine plan:

> "Front-end loaders will load the 120-T end dump trucks at the three coal levels in the pit. The dump trucks would then transport the coal from the pit area to the crusher station and dump it at the grizzly located at ground level above the crusher. The coal passes by gravity to the crusher where it is reduced to minus 2-inch size. An elevated belt conveyor then transports this material to the top of the train loadout station. This station includes two (2) silos approximately 80' diameter, 180' high, and provides a total capacity of 25,000 tons storage when required. This tonnage is equivalent to six (6) days storage during the first year of operation or three (3) days thereafter. An automatic coal sampling station will be located on top of the silos. Sample rejects will feed back to the storage silos. See Figure 16 for configuration."

Table 2, taken directly from the mine plan (Page 81), itemizes the equipment intended for use in the Shell Pearl Mine. (See Table 2).

Figure 1 (Figure 17, p. 84, in the Mining Plan) is a time schedule for the mine. This, in particular, breaks down the construction activities. (See Figure 1).

Table 3 is an anticipated employment schedule for the Shell Pearl Mine. It was provided by Shell. (See Table 3)

In material submitted in February of 1977, Shell stated that the estimated manpower level is approximately 150 people, reasonably constant over the life of the mine.

The expected distribution is as follows:

Supervisory	24
Clerical	16
Equipment Operators and Operations	55
Maintenance Personnel	55
TOTAL	150

TABLE 1

PEARL MINE - ANNUAL OPERATING CHARACTERISTICS
FOR THE LIFE OF THE MINE

Year	Overburden Moved X 1000	Total Coal Recovered X 1000	Disturbed Acres		Reclaimed Acres	
			Annual	Accumulative	Annual	Accumulative
1	11,544.0	1,191.5	58	58	0	0
2	16,372.6	2,280.6	57	115	8	8
3	13,925.5	2,241.8	46	161	20	28
4	9,050.4	2,158.9	42	203	22	50
5	9,695.6	2,000.0	6	209	20	70
6	14,186.1	1,943.9	15	224	21	91
7	6,340.2	2,308.2	31	255	22	113
8	13,043.9	1,558.6	--	255	18	131
9	5,970.7	1,080.2	28	283	17	148
10	8,639.7	1,860.7	56	339	15	163
11	7,244.3	1,609.8	34	373	60	223
12	7,257.0	2,074.5	26	399	36	259
13	7,627.5	1,853.7	27	426	40	299
14	6,304.2	1,926.3	26	452	27	326
15	6,081.5	1,815.4	29	481	25	351
16	8,748.2	2,271.9	18	499	27	278
17	7,359.6	2,082.7	22	521	33	411
18	6,348.2	1,881.7	29	550	26	437
19	4,944.2	2,023.1	--	550	19	456
20	530.6	1,566.5	--	550	15	471
21	--	--	--	550	34	505
22	--	--	--	550	45	550
TOTALS	164,682.7	38,458.0	550	550	550	550

211-10(C)(6)(V)

TABLE .

Shell Oil Company
Pearl Area

EQUIPMENT DATA SHEET

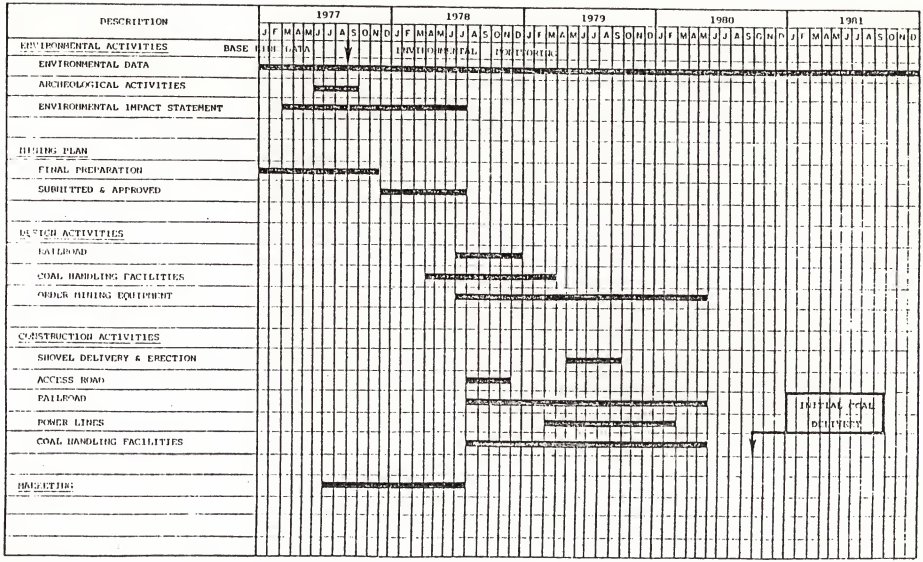
TYPE OF EQUIPMENT	NUMBER OF UNITS	FUEL USE/ YEAR & TYPE	MILES/YEAR/ UNIT	SHIFTS/DAY	DAYS/WEEK	HOURS/YEAR	YD^3 OR TONS HAULED/UNIT*	TRIPS/DAY/ UNIT	AVERAGE TRIP LENGTH	MAIN EQUIPMENT ACTIVITY
Power Shovels - 15 $Yd.^3$	2	Electric 1.8×10^6 KWH	--	2	5	4000	1.57×10^6 Yd^3	1400 Cycles/Day	--	Loading shot overburden into haulage trucks.
Front End Loaders - 17 $Yd.^3$	2	Diesel 72,000 Gal.	--	2	5	4000	1.05×10^6 Tons	1400 Cycles/Day	--	Loading coal into haulage trucks.
Haulage Trucks - 120 Ton	16	Diesel 73,900 Gal.	23,100	2	5	4000	1.41×10^6 Yd^3	42	2.2	Hauling Overburden.
Coal Haulage Trucks - 120 Ton	3	Diesel 70,000 Gal.	26,000	2	5	4000	0.7×10^6 Tons	40	2.6	Hauling Coal.
Tractors - 300 HP	3	Diesel 25,700 Gal.	N/A	2	5	4000	N/A	--	--	Utility use around loading shovels.
Tractors - 400 HP	2	Diesel 36,600 Gal.	N/A	2	5	4000	N/A	--	--	Heavy grading at spoil & top-soil dumps.
Graders - 200 HP	2	Diesel 25,000	N/A	2	5	4000	N/A	--	--	Light spoil grading, road maintenance.
Pick-Up Trucks - 3/4 Ton	17	Gasoline 2,000	20,000	N/A	N/A	N/A	--	4	2.4	Supervisor personal trans & man-trip vehicles.
Scraper - 30 Yd^3	1	Diesel 45,000	13,000	1	5	2000	70,000 Yd^3	20	2.6	Pick-up topsoil and transport to graded spoil.
Blasthole Drill - 9" Hole	2	Electric 3×10^5 KWH	N/A	2	5	4000	4×10^6 Yd^3 Drilled	N/A	N/A	Drill overburden blast holes.
Blasthole Drill - 6" Hole	1	Diesel 9,200	N/A	1	5	2000	2×10^6 Yd^3 Drilled	N/A	N/A	Drill coal blast holes.
Powder Truck	1	Gasoline 2,000	1,300	2	5	4000	N/A	2	2.6	Haul blasting agent water haulage roads
Sprinkler Truck	1	Diesel 18,000	10,400	2	4	3200	N/A	20	2.6	to control dust.

* 1 Ton of Coal = 0.83 Bank Cubic Yards

1 Cubic Yard of Overburden (average) = 1.8 Tons

(TABLE 2)

TIME SCHEDULE - SHELL FEDERAL COAL LEASE M-069945


DESCRIPTION
1977
1978
1979
1980
1981
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
ENVIRONMENTAL ACTIVITIES
BASE LINE DATA
ENVIRONMENTAL DATA
ARCHEOLOGICAL ACTIVITIES
ENVIRONMENTAL IMPACT STATEMENT
MINING PLAN
FINAL PREPARATION
SUBMITTED & APPROVED
BENCH ACTIVITIES
RAILROAD
COAL HANDLING FACILITIES
ORDER MINING EQUIPMENT
CONSTRUCTION ACTIVITIES
SHOVEL DELIVERY & ERECTION
ACCESS ROAD
RAILROAD
POWER LINES
COAL HANDLING FACILITIES
BUDGETING
INITIAL COAL DELIVERY

(FIGURE 1)

TABLE 3

ANTICIPATED EMPLOYMENT SCHEDULE

Pearl Mine Federal Lease M-069945

	Years						
Classification	-2	-1	1	2 - - - - 20		21	22
Salaried	5	22	33	33	33	15	15
Hourly	-	35	83	103	103	35	35
Construction	200	200	___	___	___	___	___
TOTAL	205	257	116	136	136	50	50

In seeking as specific a statement as possible of the construction and operating work forces associated with the Pearl Mine, the applicant, Shell Oil Co., was contacted. Table 4 was submitted by Shell Oil in a letter dated September 30, 1977.

TABLE 4:
ANTICIPATED EMPLOYMENT SCHEDULE
PEARL MINE FEDERAL LEASE M-069945

	YEARS						
Classification	-2	-1	1	2 -------	20	21	22
Supervisory	5	10	20	22	22	8	8
Clerical	-	5	11	12	12	5	5
Equipment Operators and Operations	-	20	40	50	50	20	20
Maintenance Personnel	-	20	40	50	50	20	20
Construction Mine Facilities	200	200	-	-	-	-	-
Railroad Construction	108	108	-	-	-	-	-
Access Roads	50	-	-	-	-	-	-
Transmission Lines (mine support)	30	-	-	-	-	-	-
Total	393	363	111	134	134	53	53

Source: Personal correspondence from Mr. A. T. Ireson, Shell Oil Co., to Ms. Sandi Johnson, Montana Department of State Lands, September 30, 1977.

In that same letter, Mr. Ireson stated that the actual number of employees at the mine during the two year construction phase may vary substantially. Factors such as weather, the prime contractor's contruction schedule, manpower availability, and so forth determine the actual manpower loading patterns during construction. Because the economic impact simulation model, Coal Town II, utilizes annual FTE (full time equivalent) numbers for employment, it was necessary to request more detail for the construction work force.

Table 5 reflects the construction work force expressed in manyears per year.

TABLE 5:
CONSTRUCTION WORK FORCE IN MAN-YEARS PER YEAR
PEARL MINE

Construction	Years -2	-1
Mine Facilities	169 man-years	154 man-years
Railroad Construction 1/	29.5 man-years	29.5 man-years
Access Roads	21 man-years	
Transmission Lines (Mine support)	5.5 man-years	

1/ The total of 59 man-years for years -1 and -2 was assumed to be evenly distributed over each of the two years for impact estimation.

Source: Correspondence from A. T. Ireson, Shell Oil Co., to James H. Nybo, October 12, 1977.

Other Energy Development Activity in the Area

Perhaps the most obvious initial observation about the Pearl Mine is its posture in relation to substantial other activity in the general area of Big Horn and Sheridan Counties. For that reason, it is important to place Pearl Mine development effects in the context of other activity in the impact area. For analytical purposes, this assumes other activities as specified here.

Table 6 summarizes actual production and industry project production capacity of coal in million tons per year for all present and known potential mining operations within 100 miles of the Pearl Mine, to 1985.

In inspecting the trend in the ratio of workers per million tons of coal produced, the variability seems to be declining with the passage of time. Therfore, the 1976 value of 31.8 workers per million tons was applied to the projected mining output in Table 5, yielding an estimate of primary mining employment for 1977 through 1985 for Montana, Wyoming, and the total of the two--all within 100 miles of the Shell Pearl Mine.

For comparison purposes, Table 1 on page 87 of the Decker EIS and an unnumbered table on page 503 are also included.

TABLE 6: ACTUAL AND INDUSTRY PROJECTED COAL CAPACITY AND ESTIMATED EMPLOYMENT WITHIN 100 MILES OF THE PEARL MINE, 1975 - 1985, AND FULL

OPERATION	ACTUAL & INDUSTRY PROJECTED CAPACITY: MILLION TONS/PER YEAR											
Big Horn County, Montana	75	76	77	78	79	80	81	82	83	84	85	Full
CONSOLIDATED-CX Ranch Project							1.5	3.0	5.0	5.0	5.0	5.0
DECKER East						4.9	6.0	6.0	8.0	8.0	8.0	8.0
DECKER North					2.0	2.0	3.0	3.0	4.0	4.0	4.0	4.0
DECKER West	9.1	9.1	10.1	10.5	10.5	10.5	11.0	11.0	11.0	11.5	11.5	11.5
NERCO Spring Creek 1/						3.0	7.0	10.0	10.0	10.0	10.0	10.0
SHELL OIL Pearl							1.0	2.0	2.0	2.0	2.0	2.0
WESTMORELAND Sarpy Creek Tract II 2/							2.0	2.0	4.0	4.0	4.0	4.0
WESTMORELAND Sarpy Creek Tract III 2/	4.0	4.1	5.5	5.5	5.5	5.5	10.0	10.0	10.0	10.0	10.0	10.0
COUNTY TOTAL	13.1	13.2	15.6	16.0	18.0	25.9	41.5	47.0	54.0	54.5	54.5	54.5
Crow Reservation, Montana												
AMAX East Sarpy Creek 3/							5.0	5.0	5.0	5.0	5.0	5.0
SHELL OIL Youngs Creek 4/								4.0	6.0	8.0	10.0	10.0
COUNTY TOTAL							5.0	9.0	11.0	13.0	15.0	15.0
Rosebud County, Montana												
PEABODY Big Sky	2.3	2.4	2.4	2.5	3.0	3.0	3.5	4.0	4.5	4.5	5.0	5.0
WESTERN ENERGY Colstrip 1-4 5/	6.4	9.3	9.3	10.2	11.2	14.0	14.0	14.0	17.0	18.9	20.0	20.0
COUNTY TOTAL	8.7	11.7	11.7	12.7	14.2	17.0	17.5	18.0	21.5	23.4	25.0	25.0
STATE OF MONTANA TOTAL	21.8	24.9	27.7	28.7	32.2	42.9	64.0	74.0	86.5	90.9	94.5	94.5
Sheridan County, Wyoming												
PETER KIEWIT Big Horn	0.8	1.0	1.9	1.3	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0
PETER KIEWIT Whitney						1.0	1.0	1.0	1.0	1.0	1.0	1.0
PUB. SVC. CO. OF OKLAHOMA Ash Creek				0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8
SHERIDAN ENT. Welch 6/					0.3	2.0	3.0	3.0	3.0	3.0	3.0	3.0
STATE OF WYOMING AND SHERIDAN COUNTY TOTAL	0.8	1.0	1.9	1.4	2.8	5.5	6.5	6.5	6.5	6.5	6.5	7.8

TOTAL BOTH STATES	75 22.6	76 25.9	77 29.6	78 30.1	79 35.0	80 48.4	81 70.5	82 80.5	83 93.0	84 97.4	85 101.0	full 102.3
ESTIMATED ASSOCIATED PRIMARY MINING EMPLOYMENT 7/												
MONTANA	693	792	881	913	1,024	1,364	2,035	2,353	2,751	2,891	3,005	3,005
WYOMING	25	32	60	45	89	175	207	207	207	207	207	248
TOTAL	718	824	941	958	1,113	1,539	2,242	2,560	2,958	3,098	3,212	3,253

SOURCE: Western Coal Development Monitoring System, FEA, August, 1977

1/ NERCO is a subsidary of Pacific Power and Light
2/ WESTMORELAND Sarpy Creek Tracts II and III are on Crow ceded lands (Tract III is knows as the Absoloka Mine).
3/ Crow Tribe must still accept AMAX's final proposal.
4/ Schedule may be abandoned unless Crow can negotiate a plan for royalties and reclamation by 1982. Also, DOI Secretary must lift ban on lease sales of Indian lands.
5/ Northern Cheyenne Indians have courtsuit pending to change air quality classification from Class II to Class I. Colstrip units 3 and 4 are still planned for construction and possible completion by 1982.
6/ Subsidiary of Occidental Petroleum.
7/ Employment estimates based upon a factor of 31.8 workers per million tons of coal output in Montana in 1976.

Table 7 --Summary of existing mines within 100 miles of the Decker area

Name of mine	Operator	Coal ownership	Start of production (year)	1976 annual production (million tons)[1/]	Employment[1/]	Utilization of coal	Market areas
West Decker	Decker Coal Company	Federal and State	1972	10.2	326	Electric power generation	Illinois
Big Horn	Big Horn Coal Company	Fee	1944	1.8	82	Electric power generation; industrial and domestic heating	Wyoming
Colstrip (Rosebud)	Western Energy Company	Federal and fee	1968[2/]	9.3	299	Electric power generation; industrial heating	Minnesota Illinois N. Dakota Montana
Big Sky	Peabody Coal Company	Federal and fee	1969	2.4	82	Electric power generation	Minnesota
Sarpy Creek (Absolaka)	Westmoreland Resources	Indian	1974	4.1	93	Electric power generation	Iowa Wisconsin Minnesota
Welch	Welch Coal Company	Fee	1949	.03	2	Electric power generation	Sheridan, Wyoming
Ash Creek	Ash Creek[4/] Mining Company	Fee	1978[3/]	0.5[5/]	30[3/]	Electric power generation	Oklahoma

1/ Data from coal company records as of December, 1976.

2/ 44 million tons were mined in the 35-year period, 1923-58, by the Northern Pacific Railroad Co.

3/ No coal production to date. Current employment is for development purposes.

4/ Public Service Company of Oklahoma.

5/ Estimated production rate after 1978.

Source: Entire table from Decker Mine EIS, Page 87.

TABLE 8:
COAL PRODUCTION AND UNIT TRAINS
DECKER MINE AREA

Mine	Proposed or estimated annual coal production (million tons)	Unit trains per week past crossing 1/		
		County road	Route FAS 314	Wyoming Highway 336 near Wyarno
West Decker	10	--	38.4	38.4
East Decker	6.7	25.8	--	25.8
North Extension	2.3	--	8.8	8.8
Spring Creek (P.P. & L. Co.)	10	--	38.4	38.4
CS (Consolidation Coal Co.)	3	--	--	11.5
Whitney (Peter Kiewit Sons Co.)	1.5	--	--	5.8
Youngs Creek (Shell Oil Co.)	16	--	--	61.5
Pearl area (Shell Oil Co.)	2	--	--	7.7
Ash Creek (P.S.O. Co.)	.5	--	--	1.9
Total	52.0	25.8	85.6	199.8

1/ Includes loaded outgoing and empty returning trains.

Source: Decker Mine EIS, page 503

Pearl Mine Scenarios

The ERS model Coal Town II incorporates historical activity through the base year of 1974. Scenarios must be provided from 1975 on. The model generates total population and employment, not incremental additions attributable strictly to the development under study. The incremental contribution of the mine being studied can be established as the residual between the identical run with and without the mine.

For this study, the following three development scenarios have been specified:

Scenario I: Low Development. This is the level judged to be the lowest within reason for the area. It contains those mines in the area deemed already approved and committed. In addition to producing mines in the area (West Decker and Big Horn) it includes East Decker, the North Decker extensions, and the Public Service of Oklahoma (Ash Creek) mines.

Scenario II: Most Probable Development. This is the development level judged most likely to occur based on present judgement of the Meadowlark team and various experts and opinion leaders consulted. It includes all of the developments in Scenario I plus the NERCO Spring Creek and Consolidated CX Ranch projects.

Scenario III: High Development. This is the high level of activity which could occur in the region in the next ten years. It includes some potential mines where the developer has not yet acquired control of the mineral rights and other developments judged to be less likely than the Scenario II components to occur. In addition to Scenario II it includes: Shell Oil Youngs Creek, the Whitney and Welch Mines in Wyoming, and the possible Pacific Power and Light generating complex in North Sheridan County.

Based on an assessment of the transportation network, settlement patterns, and living patterns of present mine workers, a local impact area has been defined. It includes the Decker area of Montana and Sheridan County, Wyoming. It does not include Hardin or any of Rosebud County in Montana. It is recognized that other areas of Montana in addition to the Decker area will serve as a source of construction and operating labor for the coal-based development in the Decker area; however, this is not deemed of a magnitude to be concerned about from the standpoint of quantifying impacts.

In applying the ERS Coal Town II economic impact model, this local area definition is reflected in the specification of the development scenarios. Only those developments affecting the same impact area as Shell Oil Co.'s Pearl Mine have been included in the scenarios.

The purpose of specifying the scenarios is to provide a realistic base upon which the incremental effects of the Pearl Mine can be evaluated. This approach seeks to bracket growth thresholds, beyond which particular

TABLE 9

Specification of Economic Impact model runs - Shell Pearl and NERCO Spring Creek Mine EIS Analyses.

SCENARIO	W/out Pearl 100% of MT workers in Wyoming	With Pearl 100% of MT workers in Wyoming	With Pearl 50% of MT Workers in Wyoming	W/out Spring Creek, 100% of MT workers live in Wyo.	
LOW					
MONTANA	1	7	13	19 *	
WYOMING	2	8	14	20 *	
MOST PROBABLE:					
MONTANA	3	9	15	21	
WYOMING	4	10	16	22	
HIGH					
MONTANA	5	11	17	23	
WYOMING	6	12	18	24	

* Scenarios 19 and 20 were re-specified so as to depict the low development scenario without the Pearl mine and with the Spring Creek to provide the NPRBEIS Team with an essential reference case.

developmental problems may be of much greater concern. . . examples include exceeding the capacity of the water or sewer plants, classroom space, and so forth. At a critical stage of growth, the effects of the mine on the community could be much different from those at an earlier or later period.

In addition to the specification of the three scenarios, it was also necessary to make sure that runs were made both with and without the Pearl Mine. Because one of the possible growth management strategies involved the possible establishment of a settlement on the Montana side of the border, it was also decided to make runs assuming both 50% and 100% of the Montana workers resided in Wyoming. At the 50% level, it was assumed that the other 50% lived in Montana's portion of the local impact area. Under both sets of assumptions, the model variable entitled SITEPROB, the fraction of miners living on site was specified at .95. This has also been referred to in the literature as the "capture rate". In other words, each run assumes that 95% of the workers are captured in the local impact area, and 5% live outside.

These scenarios were developed in concert with the Northern Powder River Basin EIS team on their parallel study of the NERCO Spring Creek Mine. Table 9 specifies the 24 separate runs which were made on the Coal Town II model in the quantification of the economic impacts of the Pearl and Spring Creek Mines.

Coal Mining and Employment

As was seen earlier, very little detail is available in terms of a breakdown by skills during the contruction and operating phase of the Pearl Mine. A recent study by the State of Montana has surveyed occupational employment in the coal mining industry. Three pertinent tables from that study follow. These tables (10, 11 and 12) are for the coal mining industry as it exists in 1976.

Table 13 portrays annual production in million tons, and annual employment in coal mining (SIC 12) in Montana from 1970 to 1976. The ratio of workers per million tons of coal produced was determined for the period 1970 to 1976.

TABLE 13
MONTANA COAL PRODUCTION AND EMPLOYMENT
IN COAL MINING, 1970 to 1976

Year	Coal Production, Million Tons	Employment 1/	Workers Per Million Tons
1970	3.5	100	28.6
1971	7.1	100	14.1
1972	8.3	200	24.1
1973	10.7	400	37.4
1974	14.1	500	35.5
1975	22.2	700	31.5
1976	25.2	800	31.8

1/ Source: Personal discussion with Mr. Bob Rafferty, Research and Analysis Section, Employment Security Division, Montana Department of Labor and Industry, August, 1977. Employment numbers rounded to nearest 100.

TABLE 10

ESTIMATED EMPLOYMENT IN SELECTED OCCUPATIONS IN THE COAL MINING INDUSTRY (BITUMINOUS AND LIGNITE)

(SIC 12)

OCCUPATIONAL TITLE	OES CODE	ESTIMATED EMPLOYMENT	RELATIVE ERROR %	PERCENT DISTRIBUTION	PERCENT OF ESTABLISHMENTS REPORTING THE OCCUPATION
TOTAL ALL OCCUPATIONS		805		100.00	
MANAGERS AND OFFICERS		35			
All Other Managers & Officers	19000	35	NA	4.32	100
Research & Development	19000	2	NA	0.24	17
PROFESSIONAL OCCUPATIONS		29			
Mechanical Engineer	21008	1	28.28	0.12	17
Mining Engineer	21010	18	16.23	2.71	67
Safety Engineer	21012	1	28.28	0.12	17
All Other Engineers	21900	6	NA	0.72	17
Research & Development	21900	4	NA	0.49	17
Purchasing Agent	25300	1	28.28	0.12	17
Accountants & Auditors	25401	1	43.58	0.12	17
All Other Professional	29000	1	NA	0.12	17
TECHNICAL OCCUPATIONS		12			
Computer Programmer	31000	4	27.61	0.49	17
Draftsman	32003	4	43.30	0.49	17
Surveyor	32008	3	29.43	0.37	33
All Other Technical	39000	1	NA	0.61	17
SERVICE OCCUPATIONS		3			
Guards & Watchmen	42000	2	27.38	0.24	17
Foreman, Nonworking Supervisor	44014	1	28.28	0.12	17
MAINTENANCE, CONSTRUCTION, REPAIR, MATERIAL HANDLING, POWER PLANT, MINING, & PROCESSING OCCUPATIONS		665			
Mechanic, Automotive	51008	16	18.32	1.97	33
Mine Machinery Mechanic	51041	55	6.56	6.79	50
Truck Driver	54000	62	10.47	7.65	67
Blaster	55A21	19	12.49	2.34	67
Carpenter	55A47	9	12.95	1.11	33
Continuous Mining Machine Operator	55A74	4	27.38	0.49	17
Craneman, Derrickman, & [illegible]man	55A82	4	27.38	0.49	17

OCCUPATIONAL TITLE	OES CODE	ESTIMATED EMPLOYMENT	RELATIVE ERROR %	PERCENT DISTRIBUTION	PERCENT OF ESTABLISHMENTS REPORTING THE OCCUPAT
MAINTENANCE, ETC., (CONT.)					
Driller, Machine	55B04	16	11.45	1.97	33
Dump Operator	55B07	22	25.10	2.71	17
Electrician	55B12	30	6.83	3.70	50
Foreman, Maintenance	55B29	40	5.03	4.93	67
Heavy Equipment Operator	55B52	216	5.76	26.66	67
Machinist	55B84	1	28.28	0.12	17
All Other Helpers	56900	10	NA	1.23	50
Oiler	55C06	60	12.69	7.40	67
Tipple Operator	55D21	4	27.38	0.49	17
Welders - Flamecutters	55D46	61	10.66	7.53	50
All Other Operatives	59002	1	NA	0.12	17
All Other Laborers	59003	35	NA	4.32	50
CLERICAL OCCUPATIONS		60			
Keypunch Operator	61107	4	27.61	0.49	17
Accounting Clerk	61301	3	27.68	0.37	17
General Clerk	61333	10	10.29	1.23	83
Payroll &/or Timekeeping Clerk	61351	4	27.61	0.49	17
Secretary	61368	11	14.57	1.35	67
Clerical Supervisor	61396	7	23.69	0.86	17
Stock Clerk, Storeroom, & Warehouse	62008	21	9.09	2.59	50
SALES OCCUPATIONS		1			
All Other Salesmen		1	NA	0.12	17

TABLE 11

ESTIMATED EMPLOYMENT BY MAJOR OCCUPATIONAL GROUP

IN THE COAL MINING INDUSTRY

(SIC 12)

OCCUPATIONAL TITLE	ESTIMATED EMPLOYMENT	PERCENT OF TOTAL
Major Occupational Group		
TOTAL ALL OCCUPATIONS	805 1/	100.00
MANAGERS AND OFFICERS	35	4.32
PROFESSIONAL OCCUPATIONS	29	3.60
TECHNICAL OCCUPATIONS	12	1.49
SERVICE OCCUPATIONS	*	*
MAINTENANCE, CONSTRUCTION, REPAIR, MATERIAL HANDLING, AND POWER PLANT OCCUPATIONS	665	82.61
CLERICAL OCCUPATIONS	60	7.45
SALES OCCUPATIONS	*	*

1/ Occupational totals are rounded and may not add to the total.

Employment is less than 5 people.

TABLE 12

ESTIMATED EMPLOYMENT IN MAJOR SPECIFIC OCCUPATIONS

IN THE COAL MINING INDUSTRY

(SIC 12)

OCCUPATIONAL TITLE	ESTIMATED EMPLOYMENT	PERCENT OF TOTAL
HEAVY EQUIPMENT OPERATOR	216	26.66
TRUCK DRIVER	62	7.65
WELDERS AND FLAMECUTTER	61	7.53
OILER	60	7.40
MINE MACHINERY MECHANIC	55	6.79
FOREMAN MAINTENANCE	40	4.93
ALL OTHER LABORERS	35	4.32
TOTAL	529	65.28%
TOTAL ALL OCCUPATIONS	805	100.00%

For the economic impact simulations using the Coal Town II model, it was necessary to specify construction and operating employment for each year. An explanation of the factors used in estimating these numbers follows:

Explanation of construction employment as included in the total jobs numbers for each run:

A two year construction period was assumed for each capacity addition. Based on an analysis of the construction employment associated with capacity additions to the Decker complex (the East Decker Mine) a coefficient to 37.0 workers per million tons capacity increase, for each of two years preceeding the actual capacity increase was utilized. It should be emphasized that this does not reflect the peak construction work force, which is perhaps more important for purposes of service delivery in the local area. It is appropriate, however, for the calculation of various economic impact characteristics such as derivative employment, earnings, taxes, and so forth.

The primary mine operating work force estimates were handled in a somewhat similar fashion. Permanent work force and mine output for eight mines in the May 1977 Population Update published by the Sheridan Area Planning Agency were summed, and the ratio of workers per million tons of output was calculated. This ratio, 41.5, was applied to all mine output in the scenarios, except for the mine under study and the NERCO Spring Creek Mine, being studied simultaneously. For these two mines, actual company estimates were used. The comparable parameters for the two mines under detailed study here are: Shell Pearl, 67; NERCO Spring Creek, 25.3.

For the actual mine under study, the exact estimates as provided by the applicant were used. This approach was adopted to permit internal consistency with the basic coal output projections, and to make the relationship explicit in the event that later analysis or changes in construction technology might suggest different construction work force coefficients.

The numbers used in the simulations for the Pearl and Spring Creek Mines and the PP&L powerplant can be found in Table 14.

TABLE 14:
EMPLOYMENT LOADING SCHEDULE FOR IMPACT SIMULATION:
SHELL PEARL MINE; NERCO SPRING CREEK MINE; PP&L POWER PLANT

YEAR	78	79	80	81	82	83	84	85	86	87	88
Shell Pearl Coal Jobs	0	225	183.5	111	134	134	134	134	134	134	134
Coal Tons (x 10^6)	0	0	0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NERCO Spring Creek Coal Jobs	198	268	120	207	253	253	253	253	253	253	253
Coal Tons (x 10^6)	0	0	3.0	7.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
PP & L Power Plant Jobs	0	0	500	600	700	800	1000	1400	1300	1475	950

YEAR	89	90	91	92
PP & L Power Plant Jobs, Continued	1150	875	1000	225

Source: Information for each operation from each developer.

SOCIO-ECONOMIC IMPACTS: ROLE AND SCOPE STATEMENT

The state of the art of socio-economic environmental assessment is still underdeveloped. While hundreds of applications of various methodologies have been made there is little consensus on the best or most accurate of ways of assigning costs and benefits. There are three principle problem areas with this type of analysis: (1) quantification of the "people variables" in socio-economic categories is inherently subjective; (2) it is often difficult to determine whether a given impact is actually a cost, a benefit, or some combination; (3) the scope of the impact, either positive or negative, may not coincide with the jurisdiction capable of alleviating the impact.

The case of the proposed Shell Pearl mine illustrates each of these points. Above all, it must be noted that this mine poses special conceptual problems because the costs and the benefits are not likely to be shared equally in the same jurisdictions. Even though the relative magnitude of the Pearl mine is small in comparison with many other proposed ventures, it's potential impact is large if no mechanism exists for tying together costs and benefits. The following discussion is an attempt to clarify the methodology followed in this study with regard to three key questions of: (1) what is considered to be an impact; (2) what is the areal scope of the impact area, and; (3) to what extent does the mine "pay it's own way".

I. Impacts: positive and negative

Any public policy decision constitutes a matrix of costs and benefits. A decision which is reached in accordance with what is sometimes called the "public interest" can be considered one in which the benefits exceed the costs. Unfortunately for the goal of rational decision-making, these costs and benefits are

sometimes hard to ascertain. Whether a given impact is negative or positive often is a subjective judgement, especially when it does not appear directly as either a revenue increment or as a governmental budget item.

The problem in determining whether impacts will be positive or negative (and heavy or slight in each case) can be illustrated by use of a probability decision model which takes into account the likelihood of choosing certain alternatives by the company, the individual worker or the local government. In the case of the individual worker, for example, a multitude of decisions is involved. Where will he live? Will he commute? How far? Will he bring his family? What kind of residence will he choose? What will be purchase? Where?

The worker has a number of living options. He may commute from an established community (such as Billings) outside of the immediate impact area. In this case the housing impact is neutral. The worker may attempt to find a residence in an established community in Sheridan County. In this event, a variety of other conditions determine whether the impact is positive or negative. When existing housing is available the impact can be absorbed. Demand for new construction will both stimulate the local economy and add to the local property tax base. Considered by itself, this impact is a positive one. But when the demands on property-related services are considered -- sewers, water, streets -- the costs may far exceed the incremental benefits. Because of the uncertainty about the duration of the "boom" period, however, there is not a high incentive for investment and permanent construction will lag far behind the need for housing. The most popular alternative to this problem is the mobile home. A mobile home park in Sheridan would place additional demands on limited sewer and water facilities. Mobile homes located in neighboring communities would not have this effect but would have an impact on land use. This would be true also of mobile homes scattered on plots near the mine in Big Horn county.

The point of this discussion is to illustrate the conceptual problems in assigning the costs and benefits of bringing in new workers.

Other illustrations of the mixed positive/negative nature of impacts can be seen in the case of jobs and wages. On the face of it, the Pearl mine appears capable of generating hundreds of new jobs, thus alleviating unemployment and stimulating the local economy. But if the mine is worked mainly by non-locals, then the net employment effect might be negative for the impact area. And if the effect is to drive up local wages and prices, then the proportion of the community which can no longer compete as employers or consumers is certainly affected negatively. This case reminds again that no simple "good" or "bad" label can be placed on the mine development.

Ultimately, whether an impact is perceived to be a problem or a blessing, will be up to those decision-makers who must face it -- or choose to ignore it. Citizens and experts alike continue to disagree over whether and at what rate economic or population growth is healthy. Thus, as a hypothetical case, if the people living in the impact area do not view rapid subdivision as a problem, is it appropriate for the researcher to consider it a negative impact based on his own subjective judgement? This study has taken care to apportion the relative costs and benefits of the mine according to the perceptions of the people who will be most affected.

It is important to keep in mind the distinction between two kinds of possible negative impacts associated with the Pearl mine: (1) those which can be alleviated by the revenues generated from the mine and subsequent related development, and; (2) those for which money may not be a suitable remedy. Services such as roads or schools fall in the first category. Certain non-quantifiable impacts such as altered land-use patterns or changes in community life style are examples of the second type. Even though the second are less amendable to measurement, they should be given equal consideration.

Whether an impact is positive or negative, it is sometimes not fair to assign it to a single development, such as the Pearl mine. It would be wrong to blame the costs of required community facility improvements solely upon the population demands created by new community in migrants. This is because many facilities currently are inadequate and require either upgrading or replacement anyway -- some for a long time. Simply because the latest population increment is the "straw that broke the camel's back" is not justification to blame the need for capital construction on it. On the other hand, it is not legitimate to assign no impact in a certain service area simply because the existing facility has unused carrying capacity. Some facilities are ahead of population demands in Sheridan County (library) while other are behind (fire). This study attempts to be sensitive to this problem and to assign the costs of impact equitably.

II. Scope of the impact area

The initial assumption of the socio-economic impact study is that Sheridan County will receive the major portion of the people effects of both the proposed Pearl Mine and the aggregated effect of the parallel coal activity in Big Horn County. The precise allocation of impacts, however, will depend upon a series of decisions to be made by company, individual worker , and local government unit. These decisions will affect one, several, or all of the various impact categories (i.e., land use, housing, roads, law enforcement, etc.). Thus, the scope of the impact area may be different from category to category, necessitating flexibility in degree of emphasis upon any one setting.

Even though governmental jurisdictions do not always correspond to the scope of the impacts, they are the conventional and convenient unit of analysis. They are appropriate for the purpose of available data and because they have the legal responsibility for meeting the demands created by the coal activity. Theoretically, the impact area could extend to the entire United States (in which the demand for coal is generated) or to a single special district (which might

require water supply) depending upon the activity under consideration.

This study conceptualizes both a broad and a direct impact area. The broad impact area encompasses Montana-Wyoming where legal, policy, administrative, revenue and service responsibilities rest. The direct impact area is the Decker - Sheridan-Ranchester/Dayton portion of Big Horn County in Montana and Sheridan County in Wyoming. Data analysis and evaluation will vary among these units according to the category being examined. For example, in the case of revenue availability, the broad impact area is considered while for schools the primary focus is on the Sheridan County portion of the direct impact area. Transportation is a question of concern linking both sides of the border in the direct impact area while aesthetics is an issue mainly at the mine site. This conceptual approach allows for a targeted assessment in key impact categories and a comprehensive evaluation where warranted.

Sector emphasis

No one has yet formulated a model for giving proper weight to the many categories of impact required of a comprehensive environmental impact statement. Whether recreation is more or less important than schools or fire protection can be determined only in a specific case. For this reason, socio-economic studies are required to address a laundry list of impact categories without a formula for relative emphasis. Nonetheless, there is usually some bias in the choice of things to study. It is important to explain the criteria used in this study to select the priority areas while still addressing all the points required.

In the first place, greater emphasis is placed upon the Sheridan impact area for the reasons discussed already. Virtually every service delivered by government at the local level will be affected while the same is far from true in Montana. Still, there are key service responsibilities which will be felt by Big Horn County as well, especially law enforcement, transportation, recreation and land use regulation. Some of these responsibilities will be in conjunction

with state or federal agencies. If some type of new-town settlement pattern is created, the differential emphasis in service responsibilities will shift more sharply to Big Horn County.

With regard to Sheridan County and the affected incorporated communities, three main criteria have been used to select services for study emphasis: (1) the proportion of local expenditures budgeted for the service; (2) the degree of concern among citizens over the quality of the service provision; (3) estimation of service sectors most likely to receive the greatest increment of demand. Examples in each of these categories respectively, are public schools, law enforcement and recreation. Impacts upon other services have been given less consideration where initial assessment has determined that the public sector is minimally involved, that service capacity is large or that residents express high satisfaction with current delivery. Corresponding examples include ambulance, library and solid waste disposal.

III. Mitigation strategies: "pay as you go?"

It has been noted already that that the question of the net impact of the Shell mine is clouded in the respect that the jurisdiction of benefits (primarily Wyoming) might not be equivalent. An equally knotty assessment problem involves the fact that the costs of development will most likely be felt primarily in the short run, preceding what might be substantial long run benefits. Both of these points illustrate the paradox that the mine, on paper, could pay for itself if some mechanism could be found for joining costs and benefits in the same time and space. Should the mine proposal be rejected if no such solution is discovered?

Care must be taken not to expect too much of a mitigation strategy. What seems to the observer to be a perfectly logical solution, even one which has proved to be practicable in a similar setting, might be unacceptable to the people or the decision-makers who must choose to try it.

For example, the city manager form of government has a reputation for administrative superiority but the people of Sheridan have tried it and rejected it. No responsible study would recommend this as a solution to strengthening local government capacity. Along these same lines, consolidation of city and county law enforcement has improved service in some settings but a study has been done already in Sheridan County. Based on its recommendations, some merger of support functions could evolve over time.

This point here is that the Shell Pearl mine should not be approved on the grounds that all problems could be alleviated if only the mitigation efforts were employed. What is required is an assessment of how reasonable a solution will be seen by those who are to implement it.

Primary among mitigation strategies is revenues. If the impacts truly can be alleviated by money, then it is hard to make the case against allowing the mine. It is apparent from studies of other strip mines that the amount of revenues generated from the Pearl mine could cover the socio-economic costs which are generated. But, as has been noted, the allocation of funds might not be to the direct need area. Montana decision-makers are not responsible for Wyoming services. Further, it is clear that the intent of the Montana legislature is not to assign all of the revenues to the direct and immediate costs of any single coal mine as it is believed that impacts are spread over the state as a whole and some will not be felt for several years. This explanation accounts for the large proportion of severance tax revenues which are allotted to the state equalization fund, the highway program and the coal trust fund.

What this means is that impacted communities, in both Montana and Wyoming, will have to rely upon a variety of fund-seeking strategies, including access to shared revenues and application for categorical grant programs. Thus, while there are no federal programs as yet exclusively targeted to energy-impacted communities, there are still numerous programs for which such communities have an inside

track. In this respect, grantsmanship is an important mitigation strategy. It must be kept in mind also that much federal assistance comes in the form of "formula grants" to individuals in communities as well as "project grants" to the communities. Thus, there is already a considerable potential for "hidden"assistance, or a built-in mitigation effect.